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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/806,466	03/23/2004	Shuichi Hirukawa	20455203200	1703

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EXAMINER	
SAYADIAN, HRAYR	
ART UNIT	PAPER NUMBER
2828	

SHORTENED STATUTORY PERIOD OF RESPONSE	MAIL DATE	DELIVERY MODE
3 MONTHS	03/05/2007	PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

If NO period for reply is specified above, the maximum statutory period will apply and will expire 6 MONTHS from the mailing date of this communication.

Office Action Summary	Application No.	Applicant(s)	
	10/806,466	HIRUKAWA ET AL.	
	Examiner	Art Unit	
	Hrayr A. Sayadian	2828	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *26 January 2007*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-19* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☐ Claim(s) *1-19* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☒ All b)☐ Some * c)☐ None of:

1.☒ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☑ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

PRIOR ART REJECTIONS

1. Claims 1, 7, 9, 11, 13, 15, 17, and 19 are rejected under 35 U.S.C. 103(a) as being unpatentable over PGPUB U.S. Patent Application 2003/0048825, for inventor Hirukawa [hereinafter "Hirukawa"] in view of any of: Hirukawa; Hirukawa's admitted prior art Japanese Patent Document having Publication Number 03-064980 by Matsubara, assigned to Fuji [hereinafter "HAPA-1"]; Japanese Patent Application having Publication Number 11-274644, to Tatsumi et al., assigned to Sharp [hereinafter "AAPA-1"]; and Japanese Patent Application having Publication Number 11-112087, to Matsumoto, assigned to Sharp [hereinafter "Matsumoto;" U.S. Pat. No. 6,563,850 to Matsumoto et al., which corresponds to AAPA-1 and Matsumoto, is cited in the 892 FORM provided with this Office Action]. The modification being motivated by Hirukawa and HAPA-1.

With respect to claims 1, 7, 9, 11, and 15:

Hirukawa discloses using InGaAsP active layer to generate 780 micron radiation instead of AlGaAs to avoid Al caused limitations on higher output, higher reliability, and longer life. See, for example, paragraphs [0008] and [0015].

Hirukawa discloses a semiconductor laser device (see FIG. 1 the growth of which is described by reference to FIGs. 2-4, see, for example, Column 3, ¶¶ [0056 and 0057]) in which, on an n-type GaAs substrate (Fig. 2, element 101, as described in ¶ [0057]), there are at least an n-type cladding layer (Fig. 2, element 103, as described in ¶ [0057]), a lower guide layer (Fig. 2, element 104, as described in ¶ [0057]), an InGaAsP quantum well active layer composed of one or a plurality of well layers and a plurality of barrier layers alternately disposed (Fig. 2, element 105, as described in ¶ [0057]), an upper guide layer (Fig. 2, element 106, as described in ¶ [0057]), and a p-type upper cladding layer (Fig. 2, element 107, as described in ¶ [0057]), that are stacked, wherein the quantum well active layer is stacked so that an n-side barrier layer is present on a side of the lower guide layer and a p-side barrier layer is present on a side of the upper-guide layer, the n-side barrier having thickness of 70Å or more (Fig. 2, element 105, as described in ¶ [0057], has an n-side barrier having 100 Å thickness), the upper and lower guide layers

being AlGaAs with Al mole fraction greater than 0.2 (Fig. 2, elements 104 and 106, as described in ¶ [0057], have Al mole fraction of .35), the well layers having compressive strain and the barrier layers having tensile strain (Fig. 2, element 105, as described in ¶ [0057], has the wells with compressive strain and the barriers with tensile strain), said semiconductor laser device having an oscillation wavelength of more than 760 nm and less than 800 nm (See, for example, Hirukawa, Abstract and Column 1, ¶ [0010]).

Hirukawa notes the difficulty in making AlGaAs active region laser diodes have higher output, higher reliability, and longer life because the Al in the AlGaAs active region oxidizes. See, for example, paragraph [0008]. Hirukawa proposes therefore using InGaAsP (which does not include Al, and therefore does not oxidize) as the active region. See, for example, paragraph [0015].

Hirukawa notes that in semiconductor laser devices including ridge-strips, "[g]enerally" forming the current blocking layers generates a hollow portion in the lateral face of the ridge-strip. See, for example, paragraph [0004]. Hirukawa recognizes that HAPA-1 discloses and motivates using a current blocking layer consisting of a solid layer (and therefore doing away with the hollow regions in the current blocking regions; see for example paragraph [0005] of Hirukawa) because the hollow regions have a lower refractive index and therefore current blocking layers including hollow regions make difficult producing single transverse mode oscillation.

Hirukawa recognizes that InGaAsP has lower index of refraction than AlGaAs. See, for example, paragraph [0015]. And Hirukawa therefore notes the additional benefit of using InGaAsP active layer, instead of AlGaAs active layer: The lowering of the differential in the index of refraction in devices including current blocking layers including hollow portions. See, for example, paragraph [0015], stating that using InGaAsP active layer in devices having hollow portions "generates acceptable difference of refractive index sufficient for stabilizing a single transverse mode oscillation."

Arguably, though, Hirukawa does not explicitly disclose a device having InGaAsP active layer and using a current blocking region consisting of a solid (hollow-less) layer. And Hirukawa discloses that "a hollow portion formed inside the first current

blocking layer saves an effort at preventing an overhang formed over the ridge stripe-shaped third cladding layer." See, for example, paragraph [0078] of Hirukawa.

However using solid (i.e., hollow-less) current blocking layers is notoriously well known in the art. See, for example, AAPA-1, Matsumoto disclosing solid (i.e., hollow-less) current blocking layers; and see, for example, Hirukawa and HAPA-1 disclosing and motivating using solid (i.e., hollow-less) current blocking layers.

Accordingly, to ease the production of single transverse mode oscillation in a ridge-striped semiconductor laser therefore it would have been obvious to modify the device Hirukawa discloses by eliminating the hollow portions and thus solving the problem of the hollow portions having a low refractive index, which cause difficulty in producing single transverse mode oscillation—this modification yielding solid (i.e., hollow-less) current blocking layers. Again, see, for example, paragraph [0005] of Hirukawa recognizing HAPA-1 discloses easing the production of single transverse mode oscillation in a ridge-striped semiconductor laser by eliminating the hollow portions in the current blocking layer.

With respect to claims 13 and 17:

In Column 3, ¶¶ [0041] and [0042], Hirukawa discloses, quantities for well layer compressive strain and barrier layer tensile strain being less than 3.5%.

With respect to claim 19:

In Column 5, ¶ [0073], describing FIG. 7, Hirukawa discloses using device meeting the features and limitations of claim 1 in an optical disc unit.

2. Claims 2 and 3 are rejected under 35 U.S.C. 103(a) as being unpatentable over Hirukawa in view of any of: Hirukawa, HAPA-1, AAPA-1, and Matsumoto, as motivated by Hirukawa and HAPA-1, and further in view of U.S. Pat. No. 5,636,236 to Tada et al. [hereinafter "Tada"].

With respect to claim 2:

Hirukawa does not disclose making the p-side barrier thickness smaller than the n-side barrier thickness.

However, in the active region of a laser diode, Tada discloses making the width of the p-side barrier be less than that for the width of an n-side barrier.

And Tada motivates this modification to achieve uniform hole and electron carrier distribution. See, for example, Tada columns 4 and 6, lines 3-32 and 43-47, respectively.

Accordingly, it would have been obvious to modify the disclosure of Hirukawa as modified by Hirukawa, HAPA-1, AAPA-1, or Matsumoto, as motivated by Hirukawa and HAPA-1, to make the p-side barrier thickness smaller than the n-side barrier thickness to obtain uniform carrier distribution.

With respect to claim 3:

Hirukawa does not disclose making the p-side barrier less than 70Å. Instead the three barrier layers in Hirukawa are disclosed as having 100, 70, and 100 Å thicknesses, respectively.

Again, Tada however discloses and motivates reducing the barrier width in the active regions of MQW diode lasers.

And Tada specifically discloses an embodiment wherein the n-side barrier width is 80Å and the p-side barrier width is 20Å for an InGaAsP active region MQW diode laser to obtain uniform carrier distribution. See Tada column 6, lines 42-47 describing the structure shown in FIG. 12.

Accordingly, it would have been obvious to modify the disclosure of Hirukawa as modified by Hirukawa, HAPA-1, AAPA-1, or Matsumoto, as motivated by Hirukawa and HAPA-1, to make the p-side barrier thickness less than 70Å to obtain uniform carrier distribution.

3. Claims 4, 8, 10, 12, 14, 16, and 18 are rejected under 35 U.S.C. 103(a) as being unpatentable over Hirukawa as modified by Hirukawa, HAPA-1, AAPA-1, or Matsumoto, as motivated by Hirukawa and HAPA-1, further in view of U.S. Pat. No. 6,127,691 to Fukunaga et al. [hereinafter "Fukunaga"] and U.S. Pat. No. 6,154,476 to Nishiguchi et al. [hereinafter "Nishiguchi"].

With respect to claim 4, 8, 10, 12, 14, 16, and 18:

Hirukawa discloses all of the features and limitations recited in claims 4, 8, 10, 12, 14, 16, and 18 except for making the GaAs substrate p-type, as recited in independent claim 4.

Fukunaga however explicitly discloses that similar structures can be grown from/on p-type GaAs substrate. See, for example, Fukunaga column 6, lines 12-19.

Additionally, Nishiguchi discloses using a p-type GaAs substrate to grow laser diodes to allow using/integrating the laser diode with pnp transistors (which generally have higher operation speed than npn transistors) as the driving IC transistor. See, for example, Nishiguchi, column 1, lines 24-32, motivating the use of p-GaAs as the substrate for this specific motivation.

Accordingly, it would have been obvious to modify the disclosure of Hirukawa as modified by Hirukawa, HAPA-1, AAPA-1, or Matsumoto, as motivated by Hirukawa and HAPA-1, by using p-GaAs substrate instead of n-GaAs substrate to allow the easy integration with pnp transistors.

4. Claims 5 and 6 are rejected under 35 U.S.C. 103(a) as being unpatentable over Hirukawa as modified by Hirukawa, HAPA-1, AAPA-1, or Matsumoto, as motivated by Hirukawa and HAPA-1, further in view of Fukunaga, and Nishiguchi, further in view of Tada.

With respect to claim 5:

Hirukawa, as modified by Fukunaga, as motivated by Nishiguchi, does not disclose making the p-side barrier thickness smaller than the n-side barrier thickness.

However, in the active region of a laser diode, Tada discloses making the width of the p-side barrier be less than that for the width of an n-side barrier.

And Tada motivates this modification to achieve uniform hole and electron carrier distribution. See, for example, Tada columns 4 and 6, lines 3-32 and 43-47, respectively.

Accordingly, it would have been obvious to modify the disclosure of Hirukawa as modified by Hirukawa, HAPA-1, AAPA-1, or Matsumoto, as motivated by Hirukawa and HAPA-1, as further modified by Fukunaga, as motivated by Nishiguchi, to make the

p-side barrier thickness smaller than the n-side barrier thickness to obtain uniform carrier distribution.

With respect to claim 6:

Hirukawa, and as modified by Fukunaga, as motivated by Nishiguchi, does not disclose making the p-side barrier less than 70Å. Instead the three barrier layers in Hirukawa are disclosed as having 100, 70, and 100 Å thicknesses.

Again, Tada however discloses and motivates reducing the barrier width in the active regions of MQW diode lasers.

And Tada specifically discloses an embodiment wherein the n-side barrier width is 80Å and the p-side barrier width is 20Å for an InGaAsP active region MQW diode laser to obtain uniform carrier distribution. See Tada column 6, lines 42-47 describing the structure shown in FIG. 12.

Accordingly, it would have been obvious to modify the disclosure of Hirukawa as modified by Hirukawa, HAPA-1, AAPA-1, or Matsumoto, as motivated by Hirukawa and HAPA-1, as further modified by Fukunaga, as motivated by Nishiguchi, to make the p-side barrier thickness less than 70Å to obtain uniform carrier distribution.

RESPONSE TO APPLICANTS' ARGUMENTS

5. Applicants' arguments have been considered but are found unconvincing.

Quoting paragraphs [0008] and [0009] of Hirukawa, Applicants argue that "Hirukawa itself points out that the elimination of the hollow portion in HAPA results in a laser device that fails to provide high output, high reliability or long life." Applicants then submit that "the whole purpose of Hirukawa is to correct these deficiencies." And that Hirukawa corrected these deficiencies ... by providing an active layer 105 composed of InGaAsP without Al (as a III-V compound containing at least P as V group element) as well as hollow portions 130 in the current blocking layer 112," and that "Hirukawa also makes use of an InGaAsP active layer 105 having a smaller refractive index difference relative to the hollow portions for stabilizing a single transverse mode oscillation."

Applicants therefore contend that "the hollow portions in Hirukawa's semiconductor laser device are essential to the device in Hirukawa." (underlined by Examiner for emphasis). Applicants specifically assert that "Hirukawa states that the removal of the hollow portions provided several problems in HEPA that are corrected by including the hollow portions [in Hirukawa]." Applicants therefore conclude that "not only does Hirukawa not provide any motivation to remove the hollow portions, [but that] Hirukawa actually teaches against removing these portions, and [therefore] no one of ordinary skill in the art after reading Hirukawa would intentionally go against these teachings and remove the hollow portions as suggested by the Examiner." (underlined by Examiner for emphasis).

These allegations and arguments are found unconvincing because:

A. Hirukawa's subjective intent is not at issue. Rather, the issue is what one of ordinary skill in the art (ordinary skill in this art is of high level because of the complex art/technology) would do in light of the Prior Art, including Hirukawa, HAPA-1, AAPA-1, and Matsumoto.

B. Contrary to Applicants' allegation, Hirukawa specifically recognizes in paragraph [0008] that:

> an inventor of [Hirukawa] actually manufactured as an experiment an AlGaAs based high-output semiconductor laser device based on the conventional technique, as a result of which it was confirmed that a maximum optical output thereof is approx. 180 mW, and end face destruction occurs at this optical output level. This is because the presence of active Al tends to generate Al oxide on a laser end face, which prevents implementation of higher output, higher reliability and longer life. (underlined by Examiner for emphasis).

Neither paragraph [0008] nor [0009] shows Hirukawa prohibiting (or in any way discouraging) the removal of the hollow portions. Rather, reading paragraph [0008], one of ordinary skill in the art understands Hirukawa specifically disclosing the aluminum of AlGaAs based material—not the

removing of the hollow portions as Applicants contend--causing the undesired effects (for example, limited power and life).

Examiner could not find any disclosure in Hirukawa disclosing that lack of the hollow portions in HAPA-1 caused problems, as alleged by Applicants.

Accordingly, Applicants are invited to support their allegation by pointing to a specific disclosure in Hirukawa tying the problems the inventor of Hirukawa noted to the absence of the hollow portions.

C. One of ordinary skill in the art notes that Hirukawa discloses that using InGaAsP active layer semiconductor lasers having current blocking layers including hollow portions "generates acceptable difference of refractive index sufficient for stabilizing a single transverse mode oscillation." (underlined by Examiner for emphasis). See, for example, end of paragraph [0015] in Hirukawa. If anything, therefore, one of ordinary skill in the art would want to further improve (reduce) the difference between refractive indices by following the disclosure of HAPA-1 as recognized by Hirukawa. Indeed, HAPA-1 does just that: discloses using solid (i.e., hollow-less) current blocking layers. See, for example, FIG. 11 of the present Application.

D. One of ordinary skill in the art notes that Hirukawa discloses that "a hollow portion formed inside the first current blocking layer saves an effort at preventing an overhang formed over the ridge stripe-shaped third cladding layer." See, for example, paragraph [0078] of Hirukawa. But one of ordinary skill in the art also notes that it is notoriously well known and motivated to use solid (i.e., hollow-less) current blocking layers. See, for example, Hirukawa, HAPA-1, AAPA-1, and Matsumoto.

ADDITIONAL PRIOR ART OF RECORD

U.S. Pat. No. 6,504,171 to Grillot et al. is made of record as also disclosing and motivating chirping the barrier/well thickness or compositions, or both, to increase laser diode output by making uniform the distribution of electron and holes within the active region of the

laser diode. U.S. Pat. No. 5,780,867 to Fritz et al. is made of record as disclosing adjusting thickness of active region barriers to control transport and distribution of carriers across different strained quantum wells.

CONCLUSION

6. A shortened statutory period for reply to this final action is set to expire **THREE MONTHS** from the mailing date of this action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Hrayr A. Sayadian whose telephone number is (571) 272-7779. The examiner can normally be reached Monday through Friday, 7:30 am – 4:00 pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Minsun O. Harvey can be reached on (571) 272-1835. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

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